Claims

What is claimed is:

1. An implantable cardiac rhythm device comprising:

a sensing circuit configured to sense physiological cardiac events;

a pulse generator configured to deliver electrical stimulation energy to selected cardiac tissue upon the sensing of selected cardiac events, the pulse generator having storage capacitors that store the stimulation energy;

a Lithium Pentoxide (LP) battery coupled to the storage capacitors, the LP battery providing a charging current to charge the storage capacitors to preselected energy level; and

a recharging circuit coupled to the LP battery and configured to deliver recharging current to the LP battery.

2. The device of claim 1, wherein the LP battery is a Lithium Silver Vanadium Oxide (SVO) battery.

3. The device of claim 1, wherein the LP battery is recharged upon the detection of a predetermined number of deliveries of stimulation energy.

4. The device of claim 1, further comprising a LP battery voltage detector, operative to cause the LP battery to be recharged when the LP battery voltage is detected as being below a predetermined threshold value.

5. The device of claim 1, further comprising a charging time interval detector configured to monitor the charging time interval required to charge the storage capacitor to the preselected energy level and operative to cause the LP battery to be recharged when the charging time interval is detected to exceed a preselected value.

6. The device of claim 1, wherein the LP battery has a maximum energy capacity and wherein the LP battery is recharged at a rate less than a predetermined maximum charging rate to prevent LP battery degradation.

7. The device of claim 1, wherein the LP battery is periodically recharged independent of the number of occurrences of the delivery of stimulation energy.

8. The device of claim 1, wherein the recharging circuit includes circuitry to determine the maximum voltage across the LP battery and is further operative to cause the recharge of the LP battery when the voltage drop across the LP battery exceeds a pre-determined value.

9. The device of claim 1, wherein the recharging circuit includes a receiver coil adapted for magnetic coupling to an external transmitter coil, wherein the LP battery is recharged as a function of the energy transmitted by the external transmitter coil.

10. The device of claim 1, further including a supply battery, wherein the recharging circuit is coupled between the supply battery and the LP battery and is operative to control a recharging current from the supply battery to the LP battery.

11. The device of claim 10, wherein the LP battery has a stored energy density and the supply battery has a stored energy density greater than that of the LP battery.

12. The device of claim 11, wherein the supply battery comprises a relatively high energy density battery.

13. The device of claim 11, wherein the supply battery comprises Lithium Carbon Monofluoride (CFx).

14. In an implantable medical device configured to deliver stimulation energy to selected cardiac tissue, the device including a lithium pentoxide (LP) battery, a method of recharging the LP battery comprising the step of recharging the LP battery to a preselected voltage level.

15. The method of claim 14, including the step of providing a Lithium Pentoxide (LP) battery comprising a Lithium Silver Vanadium Oxide (SVO) battery.

16. The method of claim 15, further comprising:

detecting a predetermined number of deliveries of stimulation energy; and

recharging the SVO battery upon the detection of the number of deliveries reaching a preselected value.

17. The method of claim 15, wherein the implantable device includes a battery voltage monitor, the method further comprising:

monitoring the voltage across the SVO battery; and

recharging the SVO battery when the monitored voltage drops below a preselected value.

18. The method of claim 15, further comprising terminating recharging the SVO battery when the monitored battery voltage exceeds a preselected value.

19. The method of claim 15, wherein the device includes a high voltage capacitor and recharge time interval detector, the method further comprising:

detecting the high voltage capacitor charge time; and

recharging the SVO battery when the charge time exceeds a preselected value.

20. The method of claim 15, wherein the SVO battery has a maximum energy storage capacity, the method further comprising the step of recharging the SVO battery when a preselected portion of the maximum stored energy has been depleted.

21. The method of claim 15, further comprising the step of recharging the SVO battery a preselected number of times.

22. The method of claim 15 comprising recharging the SVO battery utilizing a recharging current no greater than a preselected value to prevent degradation of performance characteristics of the battery.

23. The method of claim 15 further comprising the steps of terminating recharging of the SVO battery when the steps of either claims 15-22 result in the failure to recharge the battery.

24. The method of claim 15, wherein the implantable device includes a receiver coil adapted for magnetic coupling to an external transmitter coil, the method further comprising the step of recharging the SVO battery using energy transmitted by the external transmitter.

25. The method of claim 15, wherein the device further comprises a supply battery configured to recharge the SVO battery, further comprising the step of controlling the recharging of the SVO battery by the supply battery.

26. The method of claim 24, comprising the step of providing a supply battery formed of a relatively high energy density.

27. The method of claim 24 comprising the step of providing a supply battery comprising carbon monofluoride (CFx).

28. An implantable cardiac rhythm management device comprising:

a pulse generator adaptively configured to generate electric shocks for delivery to a patient's heart comprising:

at least one output capacitor;

charging circuitry capable of charging the at least one capacitor to produce high voltage shocks for delivery to a patient's heart;

a first battery switchably coupled to the charging circuitry, having the characteristic of a high current flow rate to fast charge the at least one capacitor;

a second battery, switchably connected in parallel to the first battery, having characteristics that enable the second battery to recharge the first battery;

a detector, coupled to the charging circuitry, that detects when the recharging current is above a predetermined threshold indicative of abnormal recharging of the first battery; and

a controller programmed to switchably enable the charging circuitry to produce the high voltage shocks, and to disable the second battery whenever an abnormal recharging current is detected.

29. The device of claim 28 wherein the controller is further programmed to enable the second battery to recharge the first battery when the voltage across the first battery falls below a predetermined minimum value.

30. The device of claim 28 wherein the first battery has a battery end of life and the controller is programmed to enable the second battery to recharge the first battery prior to reaching the end of life thereof.

31. The device of claim 28 wherein the first battery charges the at least one capacitor in a capacitor charge cycle and wherein the controller is programmed to recharge the first battery upon the occurrence of a predetermined number of capacitor charge cycles.

32. The device of claim 28 wherein the capacitor charge cycle defines a charge cycle time wherein the controller is programmed to recharge the first battery when the charge cycle time exceeds a preselected value.

33. The device of claim 28 wherein the first battery comprises a Lithium Pentoxide cell.

34. The device of claim 33 wherein the Lithium Pentoxide cell comprises a Lithium Silver Vanadium Oxide (SVO) cell.

35. The device of claim 28 wherein the second battery comprises a Lithium Carbon Monofluoride (CFx) cell.

36. The device of claim 28 wherein the controller is programmed to periodically recharge the first battery independent of the number of occurrences of the delivery of high voltage shocks.